

KEY TO COMMON INSECT ORDERS

What is a Key?

In biological sciences a "key" is a written tool used to determine the taxonomic identification of plants, animals, soils, etc. For this lab, a key will be used to identify insects to *Order*. More detailed identifications to *family*, *genus* and *species* are beyond the scope of this course, but can be accomplished using appropriate guides available from the library.

Taking a Closer Look

Because insects are so small, differentiating among species, families and even orders is often difficult. However, examination beneath a hand lens or microscope will allow you to see many of the characters mentioned in the key.

Why Use a Key?

Sometimes, you can identify an insect quickly by comparing it to pictures in field guides or on the internet. Pictures are a great tool, but the use of a key is essential to guarantee that your identification is accurate. Why? Because some insects, even ones from separate orders, can look almost exactly alike. For example, many flies (order Diptera) look almost exactly like wasps (order Hymenoptera). Using your key, you will find that a fly has 1 pair of wings, whereas wasps have 2 pairs of wings.

Key to Adult Insects Only

Remember - immature insects and adult insects are often very different. This is especially true for holometabolous (complete metamorphosis) insects where the immature stages are larvae and pupae. The key included in this guide is only useful for keying adult insects to order. Also, this key does not cover other creatures related to insects, like spiders, sowbugs, and centipedes.

Note: there are over 30 insect orders, some of which you will never encounter. The following key includes only 24 of the more common orders.

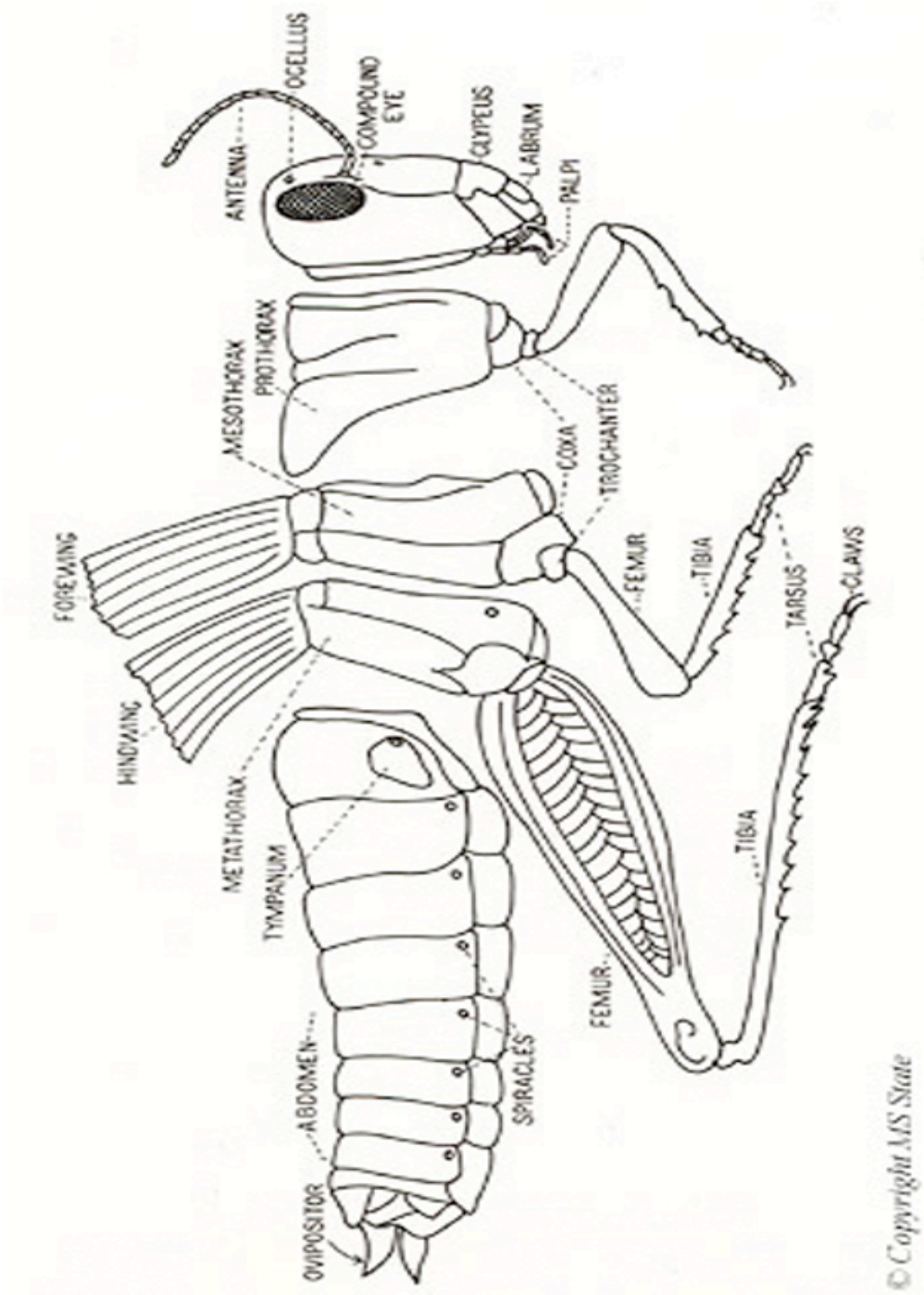
How to Use a Key

A key begins at number "1" with a set of paired, numbered statements called a couplet. Each of the two statements in a couplet is lettered with an "a" or a "b". The statements are in contrast with each other. The insect you are looking at should agree with either "a" or "b," but not with both. When you choose the statement that agrees with what your insect looks like, you will be given a different number. This number tells you what couplet you should read next. You then make another choice, and proceed in this way until the name of an insect order appears at the end of the statement you choose. You can then read the section with details on that insect order to check your accuracy in using the key.

For example, to key out a butterfly:

- Start at couplet "1." Since the butterfly has wings, pick statement "b" and go to couplet number 17.
- From couplet 17; a butterfly has 2 pairs of wings, therefore choose "b" and go to couplet 18.
- From couplet 18; the front and back wings are the same texture, therefore choose "b", and go to couplet 24.
- From couplet 24; butterflies have scaly wings and coiled tongues, so pick "a", which tells you the order name, Lepidoptera.

BODY PART TERMINOLOGY



KEY TO COMMON INSECT ORDERS

- 1** a. Without wings; all of the abdominal segments visible in a top view of the insect.....2
 b. With wings; wings may be difficult to see because they are hidden by hard wing covers (as with beetles). In these cases, the wing covers lie over the back and hide all or parts of the abdomen.....17
- 2** a. Without legs, eyes, or antennae; living under a waxy or cottony covering and occurring in colonies firmly attached to tree twigs, fruit, or leaves (e.g. scale insects)..... HEMIPTERA (suborder STERNORRHYNCHA)
 b. Legs, antennae, and (usually) eyes present.....3
- 3** a. Abdomen ending in three long, thread-like tails; antennae long..... THYSANURA
 b. Abdomen without long tails; antennae may be long or short.....4
- 4** a. Antennae are shorter than the head, and not easily seen; body flattened from side-to-side or from top-to-bottom; parasites on animals.....5
 b. Antennae longer than the head, easily seen; not usually parasites.....7
- 5** a. Body flattened from side-to-side; legs long and able to jump; with siphoning mouthparts.
SIPHONAPTERA
 b. Body flattened from top-to-bottom; legs short and not able to jump.....6
- 6** a. Abdomen sac-like and without distinct segments; eyes clearly visible; tarsi 5-segmented; about 1 cm long; sheep parasites..... DIPTERA
 b. Abdominal segments distinct; eyes small or absent; tarsi 1- to 2-segmented; less than 3 millimeters long.....PHTHIRAPTERA
- 7** a. Body strongly constricted between the thorax and abdomen.....HYMENOPTERA
 b. Thorax and abdomen broadly joined.....8
- 8** a. Body scaly; a coiled tongue sometimes visible; usually found on tree trunk.....LEPIDOPTERA
 b. Body not scaly.....9
- 9** a. With a sucking beak; the beak of some may seem to come from between the front legs.....10
 b. Beak absent, chewing mouthparts.....11
- 10** a. With 2 tube-like projections near the end of the abdomen; soft-bodied and living in colonies on plants; antennae long; beak arises near the front legs..... HEMIPTERA (suborder STERNORRHYNCHA)
 b. Without tube-like projections on abdomen; beak arises from front of head.....HEMIPTERA (suborder HETEROPTERA)
- 11** a. Tarsi either 5-segmented or the hind legs adapted for jumping.....12
 b. Tarsi with less than 5 segments and the hind legs not adapted for jumping.....14
- 12** a. Hind legs adapted for jumping.....ORTHOPTERA
 b. Hind legs not adapted for jumping.....13
- 13** a. Body flattened from top-to-bottom, head hidden from above by thorax.....BLATTODEA
 b. Body stick-like, not flattened; head not hidden by thorax.....PHASMATODEA

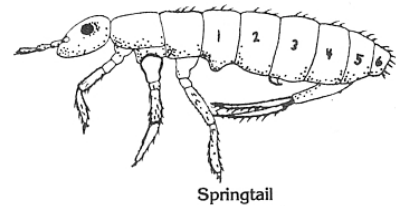
- 14 a. Ant-like appearance, except with soft, white bodies; 4-segmented tarsi; eyeless; antennae resemble a string of round beads; thorax and abdomen are broadly joined.....ISOPTERA
 b. Not fitting the description of 14a; eyes usually well-developed.....15
- 15 a. With a forked tail near the end of the body used for jumping; this tail may be folded under the body.....COLLEMBOLA
 b. Without a forked tail.....16
- 16 a. Oval-shaped and louse-like in appearance; antennae long, thread-like.....PSOCOPTERA
 b. Body narrow; found on leaves and flowers.....THYSANOPTERA
- 17 a. With only one pair of wings, the hind pair reduced to small structures that resemble golf tees (halteres).....DIPTERA
 b. With two pairs of wings, although the first pair may be hardened and do not function in flight (as with beetles).....18
- 18 a. Front wings thicker in texture than hind wings for all or part of area.....19
 b. Front and hind wings both of the same texture throughout.....24
- 19 a. Front wings hard or leathery in texture throughout and almost always meeting in a straight line down the center of the back.....20
 b. Front wings parchment-like or leathery throughout or on the basal half only - they do not meet in a straight line down the center of the back. In the lace bugs (HEMIPTERA), the entire top of the insect resembles lace.....21
- 20 a. Front wings short, leaving much of the abdomen exposed; a pair of pincher-like appendages extend from the end of the abdomen.....DERMAPTERA
 b. Front wings usually cover all of the abdomen; never with abdominal appendages.....COLEOPTERA
- 21 a. With a jointed beak; basal part of the wing thickened and the tip membranous. Antennae with 5 or less segments.....HEMIPTERA
 (suborder HETEROPTERA)
 b. With chewing mouthparts; front wings parchment-like throughout; antennae with many segments.....22
- 22 a. Hind legs adapted for jumping.....ORTHOPTERA
 b. Hind legs not adapted for jumping.....23
- 23 a. Front legs adapted for capturing prey (praying mantises).....MANTODEA
 b. Front legs not adapted for prey; body flattened from top-to-bottom; head hidden from above by thorax.....BLATTODEA
- 24 a. Wings with scales on all or part of their area; siphoning mouthparts in the form of a coiled "tongue".....LEPIDOPTERA
 b. Wings without scales, although they may have hairs.....25
- 25 a. Wings long, narrow, veinless, and all 4 are of equal size and have fringes with long hairs; small insects about 2 mm long; tarsi 1- or 2 segmented.....THYSANOPTERA
 b. Not fitting the description in 25a.....26

- 26** a. Mouthparts composed of a beak arising far back on the underside of the head near the front legs; wings held roof-like over the body, the hind pair smaller than the front pair.....HEMIPTERA (suborder AUCHENORRHYNCHA)
- b. Mouthparts not in the form of a piercing beak, although the front of the head may be prolonged into a long snout; wings not held roof-like over the body; usually the hind pair of wings are about the same size as the front pair OR the abdomen has 2 or 3 long, thread-like tails.....27
- 27** a. With many cross-veins (more than 15) in each wing.....28
- b. With few cross-veins, or the veins are indistinct.....32
- 28** a. Antennae about as long as the head and thorax together, or longer.....30
- b. Antennae short and bristle-like, same length as head alone or shorter.....29
- 29** a. Hind wings much smaller than front wings; occasionally, hind wings absent; abdomen ending in 2 or 3 long, thread-like tails.....EPHEMEROPTERA
- b. Front and hind wings nearly equal in size; no abdominal tails.....ODONATA
- 30** a. Abdomen ending with 2 short tails.....PLECOPTERA
- b. Abdomen without tails.....31
- 31** a. Head prolonged into a snout; the tip of the abdomen sometimes resembles a scorpion tail.....MECOPTERA
- b. Head not prolonged into a snout.....NEUROPTERA
- 32** a. All four wings long, narrow, equal-sized, without distinct veins; wings about twice the body length.....ISOPTERA
- b. Not fitting the description in 32a.....33
- 33** a. Wings hairy; antennae thread-like and usually as long as or longer than the body; mouthparts indistinct; front and hind wings nearly equal in size.....TRICHOPTERA
- b. Wings not hairy; chewing mouthparts present; hind wings noticeably smaller than the front wings.....34
- 34** a. Tarsi 2- or 3-segmented; small insects less than 3mm long. Never constricted between the thorax and the abdomen.....PSOCOPTERA
- b. Tarsi 4 or 5 segmented; size variable; most are constricted between the thorax and the abdomen.....HYMENOPTERA

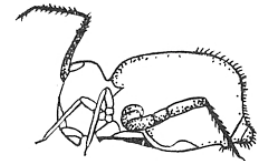
DESCRIPTION OF COMMON INSECT ORDERS**1. Collembola: Springtails**

(*colla* = glue + *embolon* = wedge or peg)

Collembola are tiny, wingless insects with chewing mouthparts and incomplete metamorphosis (hemimetabolous). The antennae are usually conspicuous. The scientific name comes from the fact that on the first abdominal segment there is a short tube (called a “collophore”) with which springtails can stick to smooth surfaces. The common name, springtail, refers to the springing structure (furcula) near the tip of the abdomen. Some Collembola can spring several inches, and because of their tiny size seem to disappear when they jump. One species is dark colored, and on warm winter days large numbers of them will come out of hibernation to bask in the sun on the surface of the snow. These are often called “snowfleas”. The Collembola are of no economic importance, but they are plentiful and can be found in many kinds of habitats under loose bark, logs, stones, and in damp leaf litter where they feed on decaying organic material.



Springtail

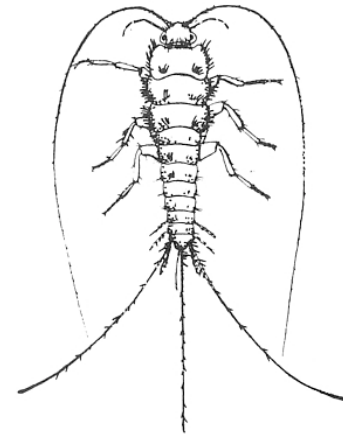


Springtail

2. Thysanura: Silverfish, Firebrats, Bristletails

(*thysanos* = tassel + *oura* = tail)

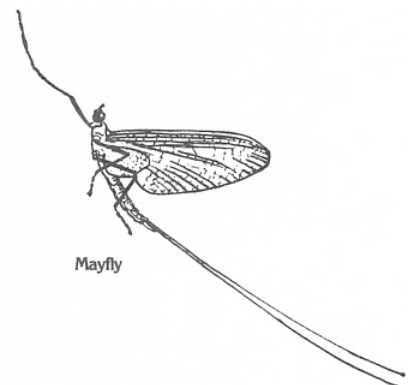
Thysanura are wingless insects with chewing mouthparts, long, thread-like antennae, incomplete metamorphosis, and three thread-like tails at the end of the abdomen. There are also tiny appendages on the underside of the abdomen. In some species the body is covered with scales. Two species, the silverfish and the firebrat, are considered pests. The firebrat prefers warm places, such as in kitchens near ovens. The silverfish is often found in homes. Both species eat starchy materials, such as flour and paste. In bad infestations, silverfish may roughen book covers and papers on which they chew. Jumping bristletails are found out of doors under rock piles or in forest litter.



Silverfish

3. Ephemeroptera: Mayflies (*ephemeris* = living but a day)

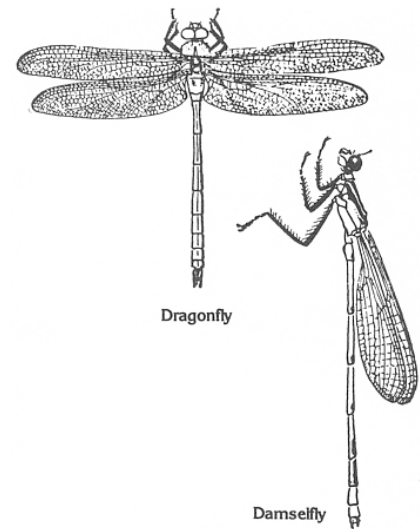
Mayflies are small- to medium-sized, soft-bodied insects with incomplete metamorphosis. Mayflies have undeveloped chewing mouthparts, 2 or 3 thread-like abdominal tails, and short, bristle-like antennae. The wings are membranous, with many cross-veins, and the hind pair is much smaller than the front pair. (Note: some small species have only one pair of wings, but most species have two pairs of wings.) Immature mayflies, called “naiads,” are aquatic. Mayflies have an unusual life-cycle: they molt after they grow wings. Most insects stop molting (shedding their skins) after they become winged-adults, but mayflies undergo one additional molt. The winged mayfly that emerges from the naiad has hairy wings and is called a “dun,” or a “subimago.” After a brief period, the subimago molts to produce the “imago,” which has clear wings. The subimago is not a true adult - only the imago is able to mate. Mayfly adults live only a short time, usually less than one week. The development of the naiad is much longer, taking 1 to 3 years. These insects often emerge in great hordes and can be a nuisance. They cover the sides of buildings, sidewalks, and streets to the extent that walking and driving are difficult. Despite the nuisance they sometimes cause, mayflies are valuable as food for many fishes.



Mayfly

4. Odonata: Dragonflies and Damselflies (*odontos* = tooth)

Odonata are medium- to large-sized insects with bristle-like antennae, chewing mouthparts, and 2 pairs of membranous wings. The front and hind wings are of equal length with many cross-veins. The abdomen is long and narrow. In some dragonflies, the abdomen tapers to a point like a long fang, or tooth (hence the name Odonata). Immature Odonata are underwater predators. They are fully aquatic, complete with gills. There are two main groups of Odonata: the damselflies and the dragonflies. Damselflies are weak fliers and are found along the banks of streams and ponds. Their wings are narrow at the bases. Dragonflies are strong fliers, and often range long distances from water. They can hover and quickly change direction when in full flight. Because Odonata are predaceous on other insects, they are considered beneficial.

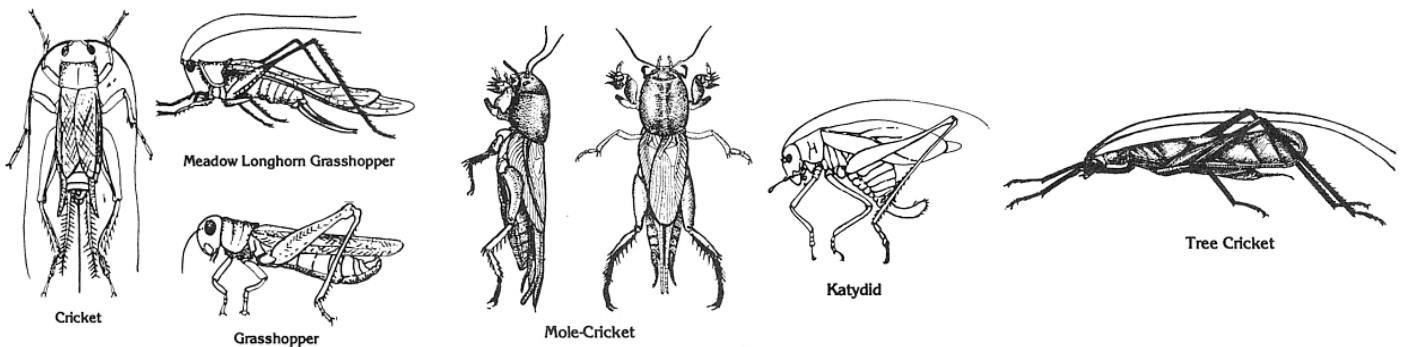


5. Orthoptera: Grasshoppers, Crickets, Katydid

(*orthos* = straight + *ptera* = wings)

Orthoptera include crickets, grasshoppers, katydids, and other medium- to large-sized insects with incomplete metamorphosis and jumping legs. Some Orthoptera are wingless, but most have 2 pairs of wings. When there are 2 pairs of wings, the front wings are usually leathery or parchment-like in texture. The hind wings are membranous and folded (like a fan) underneath the front wings. The front wings (called “tegmina”) are straight and narrow, which is the basis for the scientific name of this order. The antennae of Orthoptera are long; in many cases, longer than the rest of the body.

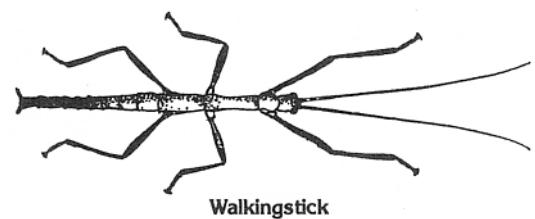
Note: in some insect keys, the Orthoptera also includes praying mantids, walking sticks, and cockroaches.



6. Phasmatodea (Phasmida): Walking Sticks

(*phasm* = phantom)

Walking sticks are long, stick-like, wingless insects with chewing mouthparts and incomplete metamorphosis. Walking sticks are herbivores, and are closely related to mantids, crickets, and grasshoppers, and are included in the order Orthoptera in some insect guides.



7. Mantodea: Praying mantids

(*mantis* = soothsayer)

Large, “raptorial” front legs make these insects easy to recognize. Praying mantids have 2 pairs of wings, and the front pair is thickened, much like the front pair of grasshopper wings. Mantids have chewing mouthparts, large eyes, and incomplete metamorphosis. The only insects sometimes mistaken for praying mantids are the “mantidflies.” Mantidflies are in the order Neuroptera, and resemble small praying mantids. Like all insects in Neuroptera, though, the front wings on a mantidfly are not thickened as with true mantids. Mantids are often found in vegetation, gardens, and similar habitats. They are predators and feed on almost any creature that they can capture. Praying mantids are closely related to walking sticks, crickets, and grasshoppers, and included in the order Orthoptera in some insect guides.

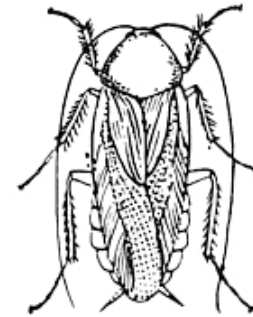


Praying mantid

8. Blattodea: Cockroaches

(*blatta* = cockroach)

Cockroaches are flattened insects with 2 pairs of wings, chewing mouthparts, and incomplete metamorphosis. Cockroaches, like crickets and grasshoppers, have thickened front wings called “tegmina.” Cockroaches are fast runners, and their flat shape allows them to fit under rocks, logs, and other tight places. They are omnivores, feeding on virtually anything organic. Several species are pests, including German and American cockroaches, which commonly infest buildings. Other species, such as the wood roach, rarely enter homes and are important scavengers.

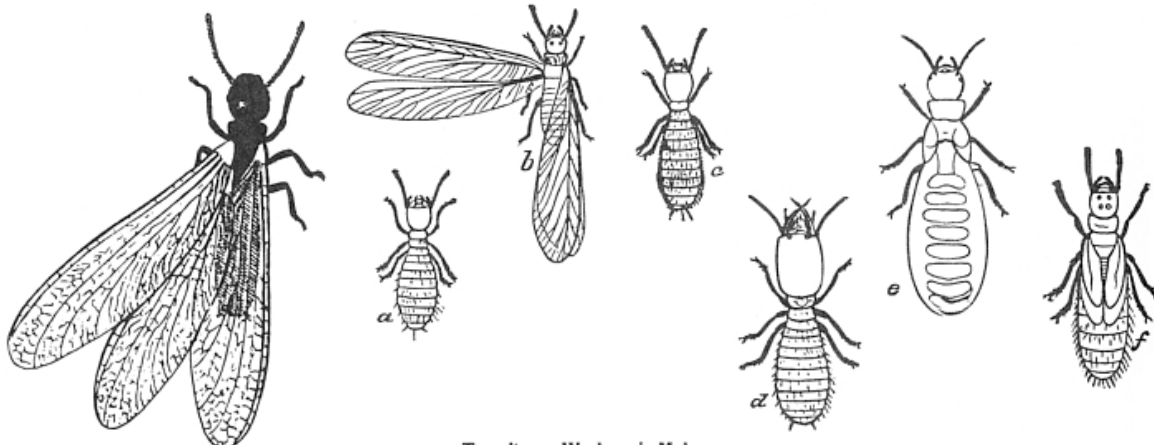


Cockroach

9. Isoptera: Termites

(*isos* = equal + *ptera* = wings)

Termites are small soft-bodied, social insects with incomplete metamorphosis, chewing mouthparts and “beaded” antennae composed of a series of round segments. They nest in colonies and stay underground at all times, except for the kings and queens, which are active during the swarming season. The colony is made up of castes, including many workers, some soldiers, and a queen. Termites either feed on wood that is beneath the soil or they build hollow, mud-like, shelter tubes from the ground to reach wood not in contact with the soil. The shelter tubes protect the termites from being exposed to light, dry air, and predators. In nature, termites are an essential part of the ecosystem, but when termites attack homes and other structures, they are serious pests. Ants that nest or swarm around homes are often confused with termites. (Note: some taxonomists include Isoptera within Blattodea).



Termite:
Swarmer

Termite: a. Worker, b. Male;
c, e, f, stages of female; d, soldier.

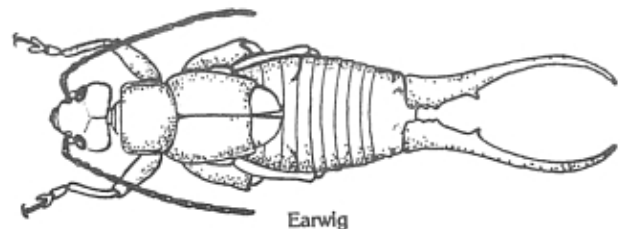
Ants can be distinguished from termites by making the following comparisons:

Termites:	Ants:
Abdomen broadly jointed to the thorax	Abdomen narrowly jointed to the thorax
Antennal segments round, and all of equal size	First antennal segment as long as the rest combined
Workers and soldiers lack eyes	Workers and soldiers almost always have eyes
Wings of swarmers are twice the length of the body	Wings of swarmers are less than twice the body length
All wings the same length	Hind wings are shorter than front wings

10. Dermaptera: Earwigs

(*derma* = skin + *ptera* = wings)

Earwigs have incomplete metamorphosis, chewing mouthparts, and either 2 pairs of the wings or no wings. The front wings, when present, are short and hardened, and act as coverings for the membranous back wings. Earwigs are easy to recognize by the large pincers on the end of the abdomen. Female earwigs lay eggs under rocks or logs and guard both the eggs and, for a short time, the nymphs. Earwigs are nocturnal and are not often seen, although they are fairly common. They sometimes fly to lights at night, and are occasionally pests on fruit. It was once believed that earwigs entered ears while people were sleeping. Although any small creature can potentially get inside someone's ear, earwigs are not especially likely to do this.

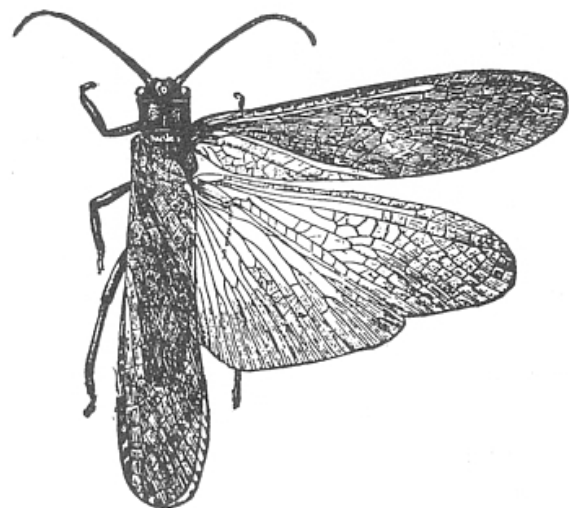


Earwig

11. Plecoptera: Stoneflies

(*plekos* = plaited + *ptera* = wings)

Stoneflies are small- to medium-sized insects with 2 pairs of membranous wings held flat over the back when not in use. The front wings are long and narrow, and the hind wings are enlarged and folded fanwise like grasshopper wings. Both wing pairs have many cross-veins. They have chewing mouthparts and long antennae. The abdomen ends in 2 short, thread-like tails. Metamorphosis is incomplete, and the aquatic nymphs (naiads) live under rocks in fast-flowing streams. The adults usually do not range far from water. Plecoptera are not of great economic importance except as a source of food for fishes. The naiads are sometimes collected and sold as fish bait, but they are hard to keep alive in captivity. Some species, called winter stoneflies, are among the first winged insects to appear in the year. They can be found clinging to bridges in late winter or very early spring. They are black or brown.

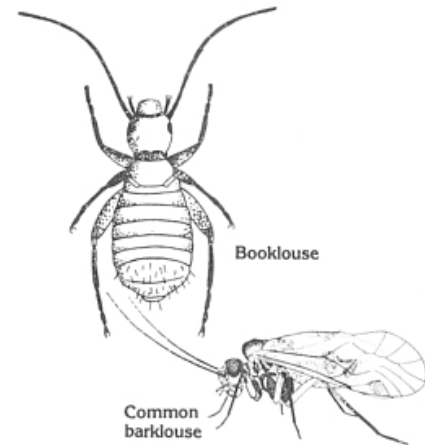


Stonefly

12. Psocoptera: Psocids, Barklice, Booklice

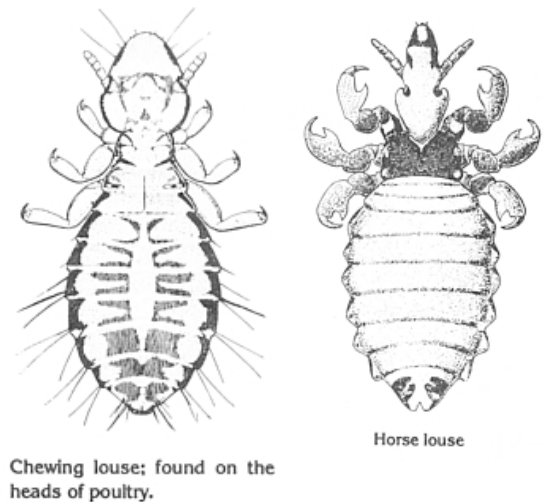
(*psocho* = to rub or grind into small pieces + *ptera* = wings)

Although the name "Psocoptera" suggests that these insects grind wood, psocids primarily feed on tiny fungi that grows on moldy or decaying wood. They are small, delicate insects, with long thread-like antennae, and chewing mouthparts. They are wingless or have 2 pairs of wings. Metamorphosis is incomplete. Booklice are wingless and are common in homes, often occurring in large numbers around musty books or in humid flour or meal. Barklice are usually winged and can be found scurrying on tree bark.

**13. Phthiraptera: Lice**

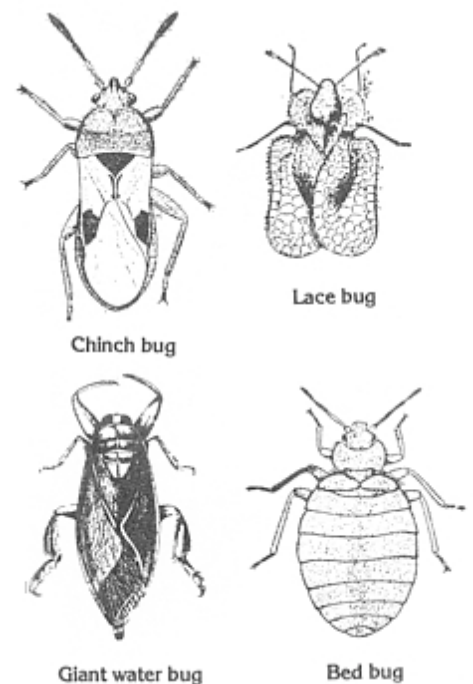
(*phthir* = lice + *aptera* = wingless)

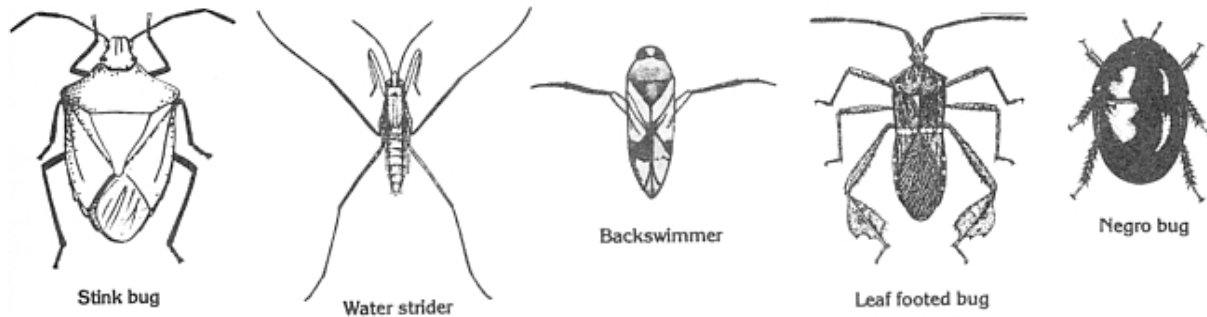
Lice are tiny, flattened, wingless insects with soft bodies and incomplete metamorphosis. All lice are external parasites of birds and mammals. Lice antennae are short, and the eyes are absent or poorly developed. Most lice are host specific; that is, each louse species will live on only one kind of host, and the entire life cycle is spent on the host animal. The eggs (called "nits") are glued to the host's hair or feathers. There are two main groups of lice: chewing lice and sucking lice. Chewing lice have chewing mouthparts and feed on the hair or feathers and skin of their host. Although chewing lice can cause much irritation, they do not spread disease organisms as do the sucking lice. Sucking lice feed on blood, and often transmit diseases between organisms. No species of chewing lice are parasitic on humans, but there are several types of sucking lice (body, head, and crab lice) that attack humans.

**14a. Hemiptera (suborder Heteroptera): True Bugs**

(*hemi* = half + *ptera* = wings)

Although many kinds of arthropods are called "bugs," the "true bugs" all belong to the order Hemiptera. For all insects in this order, "bug" is written as a separate word (e.g. plant bug). Whenever an insect or related arthropod in another order is called a bug, the names are written as one word (e.g. mealybug). All Hemiptera have sucking mouthparts and incomplete metamorphosis. They typically have 2 pairs of wings. In the suborder Heteroptera, the front pair is leathery at the base and membranous at the tip. When at rest, the wings lie flat on the back. Some true bugs are wingless or are short-winged or have atypical front wings (e.g. lace bugs). The suborder Heteroptera can be difficult to distinguish from suborders Sternorrhyncha and Auchenorrhyncha. Heteropterans have jointed beaks that arise from the front of the head, whereas Sternorrhynchans and Auchenorrhynchans have beaks that arise farther back on the head and sometimes seem to come from between the front legs. Also, the wings of Heteropterans are flat over the back while those of Sternorrhynchans and Auchenorrhynchans are most often held roof-like over the back. Many true bugs are important plant pests, and a few are blood-sucking pests of animals, including humans. Some bugs are beneficial predators of other insects.

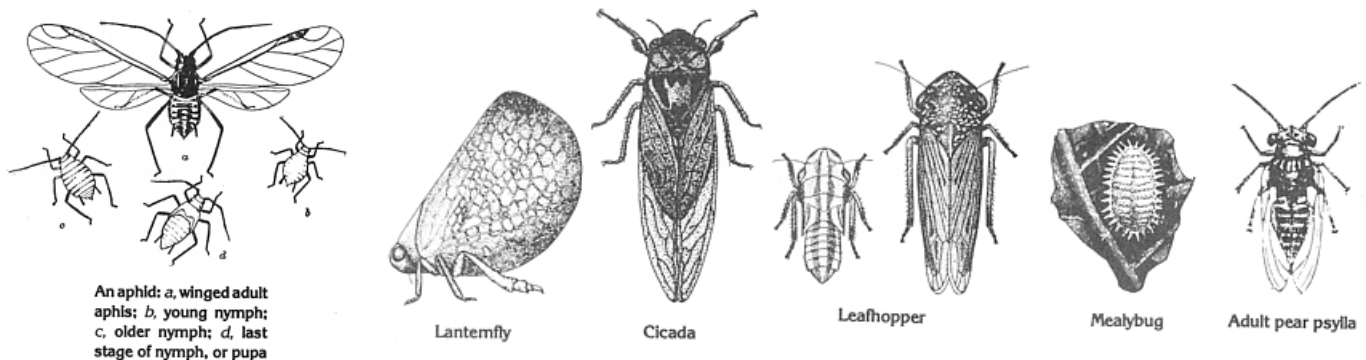




14b. Hemiptera (suborders Sternorrhyncha and Auchenorrhyncha):

Aphids, Cicadas, Scales, Leafhoppers, and others

Members of the suborders Sternorrhyncha and Auchenorrhyncha can be difficult to distinguish from the suborder Heteroptera. All three suborders have piercing mouthparts, 2 pairs of wings, and incomplete metamorphosis. Unlike the Heteroptera, the mouthparts of Sternorrhyncha and Auchenorrhyncha arise further back on the head, near the front legs. The wings, when present, are not like Heteroptera wings: they do not have a thickened basal section and a clear tip, and they are usually held “rooflike” over the back instead of flat. All Sternorrhyncha and Auchenorrhyncha are plant feeders. The largest members are the cicadas (Auchenorrhyncha), which produce the familiar buzzing sound during summer months. Adult cicadas damage twigs and the subterranean nymphs feed on tree roots. Some cicada species have a long life-cycle, with the nymphs taking 17 years to grow. Aphids (Sternorrhyncha), often called “plant lice,” are soft-bodied and have 2 short tubes projecting from the ends of the abdomens. Aphids are usually wingless and live in colonies on plants. Aphids are often pests, spreading diseases to crop and garden plants.



15. Thysanoptera: Thrips

(*thysanos* = fringe + *ptera* = wing)

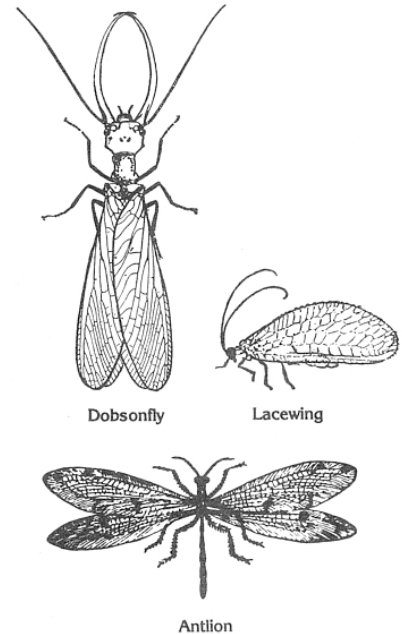
Generally all the members of this order are tiny, narrow insects with short antennae. They are either wingless or have 2 pairs of long narrow wings fringed with long hairs. When at rest, the wings are held flat over the back. Thrips are poor fliers and their flights resemble flea hops. Their mouthparts are not fully developed, and they feed by scraping leaf surfaces and sucking the sap that flows from the wounds. Some thrips are important pests, causing leaf wilt or causing flower buds to drop or to open unevenly. Flower petals may be streaked or browned by thrips damage. Some also spread plant diseases. A few thrips species are beneficial, feeding on fungi and other insects.



16. Neuroptera: Lacewings, Dobsonflies, Antlions, others

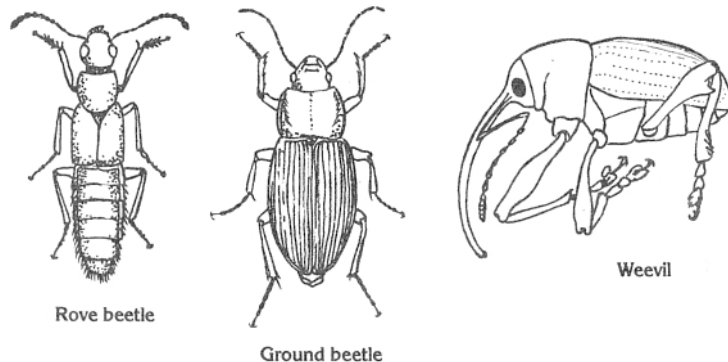
(*neura* = nerves + *ptera* = wings)

Neuroptera have chewing mouthparts, long antennae, and 2 pairs of membranous wings with many cross veins. Metamorphosis is complete. Most members of this order are small- to medium-sized. The dobsonfly is larger, ranging from 1 1/2 to 3 1/2 inches long. Members of this order are parasitic or predaceous on other invertebrates. Antlions are well-known members of this group. The larvae, called “doodlebugs,” catch insects at the bottom of pits that they construct in sandy soil. Adult antlions resemble damselflies, but have longer antennae. Other common Neuroptera include: owlflies, mantidflies, dobsonflies, and lacewings. The mantidflies resemble miniature praying mantids. The green lacewing is a common representative of this order and is a beneficial insect because it destroys aphids. The larva of the green lacewing is commonly called the “aphid lion.” Note: some keys place dobsonflies, alderflies, and fishflies into a separate order, the Megaloptera.

**17. Coleoptera: Beetles**

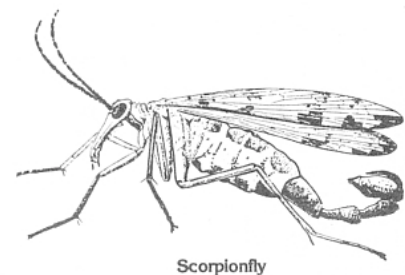
(*coleos* = sheath + *ptera* = wings)

All beetles have distinctive front wings (called “elytra”) which form a covering or sheath over the hind wings. Usually the elytra are hard and meet in a straight line down the center of the back and extend to the tip of the abdomen. An important exception: the elytra of rove beetles are short, leaving most of the abdomen exposed. Some beetles, such as lightning beetles, soldier beetles and blister beetles, have elytra that are not as hard as those of most other beetles. Most beetles can fly, but the flying wings are hidden under the elytra when the beetles are at rest. All beetles have chewing mouthparts, but the jaws of weevils are at the end of a snout. The snout is sometimes long and thin and resembles a sucking beak. The antennae of beetles may be long or short and of many different shapes. Beetles undergo complete metamorphosis, and the larvae of some have special common names, such as white grubs and wireworms. Coleoptera contains the most members of any insect order, with over 300,000 known species worldwide.

**18. Mecoptera: Scorpionflies and Hanging Scorpionflies**

(*mecos* = long + *ptera* = wings)

Scorpionflies are medium-sized, soft-bodied insects with complete metamorphosis, 2 pairs of wings, long antennae, and chewing mouthparts. Scorpionflies are easy to identify because of their long “noses.” Scorpionflies get their names because on some species, the male abdomen ends in a tail resembling that of a scorpion. Most common scorpionflies in are orange in color. Larval scorpionflies live in leaf litter and feed on a variety of organic material. Most adults are

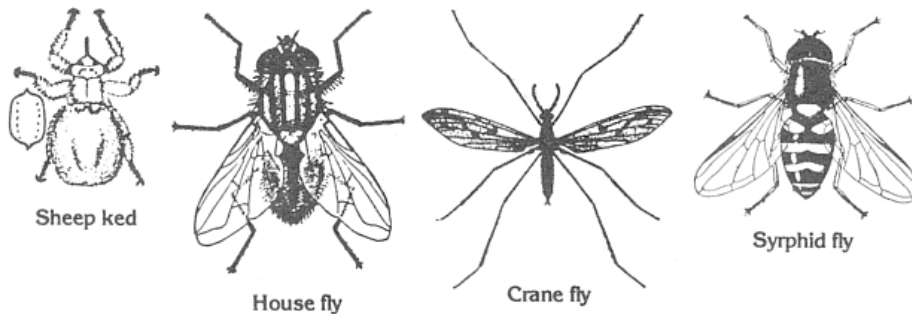


predators.

19. Diptera: Flies, Gnats, Midges, Mosquitoes

(*di* = two + *ptera* = wings)

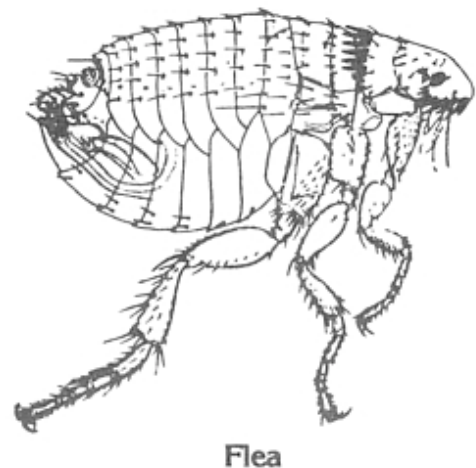
All Diptera have modified sucking mouthparts, and they are the only group of commonly encountered insects which have only 1 pair of wings. Where the second pair of wings would be located, there is a small structure called a “halter” which looks like a tiny golf tee and which helps in balance. A few rarely encountered insects in other orders have only 1 pair of wings, such as the Strepsiptera and a few cricket species, but these insects usually have chewing mouthparts. Some rarely encountered flies, such as the sheep ked, are wingless. Fly antennae may be short or long and of various shapes. The eyes are typically very large. In many species, the mouthparts are adapted for piercing plants or animals and sucking sap or blood. In some cases, as with house flies, the mouthparts may be capable of only “sponging” liquid food. House flies are able to feed on solid food only by first dissolving it with excreted saliva. Flies have complete metamorphosis, and the larvae are usually called maggots. Many kinds of flies are serious economic pests of plants and animals. Flies are the most important insects in regards to the health of man and animals because of the diseases they spread. Many kinds of flies are beneficial as parasites and predators of pest insects, or as plant pollinators. When writing the common names of true fly species, “fly” is always written as a separate word, such as “house fly,” “deer fly,” or “stable fly.” When “fly” is part of the name of an insect in another order, it is written as a compound word, such as “dragonfly,” “butterfly,” or “caddisfly.”



20. Siphonaptera: Fleas

(*siphon* = tube + *aptera* = without wings)

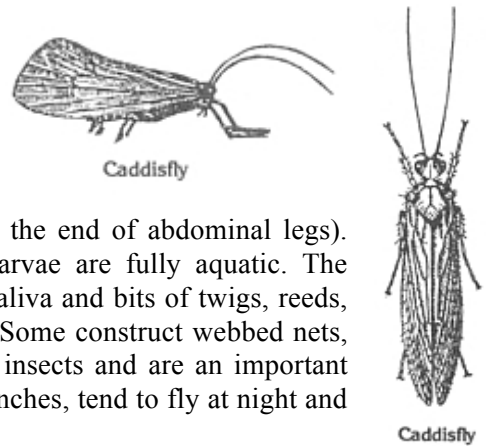
Siphonaptera are always wingless and have sucking mouth parts. They are flattened from side to side, have long legs and are good jumpers. Their antennae are short and eyes are usually present. All fleas are parasites on the bodies of mammals or birds. Fleas lay eggs while they are on the host, and the eggs fall to the ground. When the larvae hatch they feed on bits of skin and hair in the host animal's lair or den. After several molts, the larva pupates. When the adult emerges from the pupa, it can go for months without food. Most flea species prefer one or two types of host, but they often will take experimental tastes of other animals. Dog and cat fleas will bite humans but will not live on them. One of the most dread diseases of the past was bubonic plague, which was spread by fleas from rat to man and man to man. Bubonic plague, or the "Black Death," killed 70,000 people in London, England between 1664 and 1666. In the 1500's the Black Death claimed 25 million lives in Europe.



21. Trichoptera: Caddisflies, Caseflies

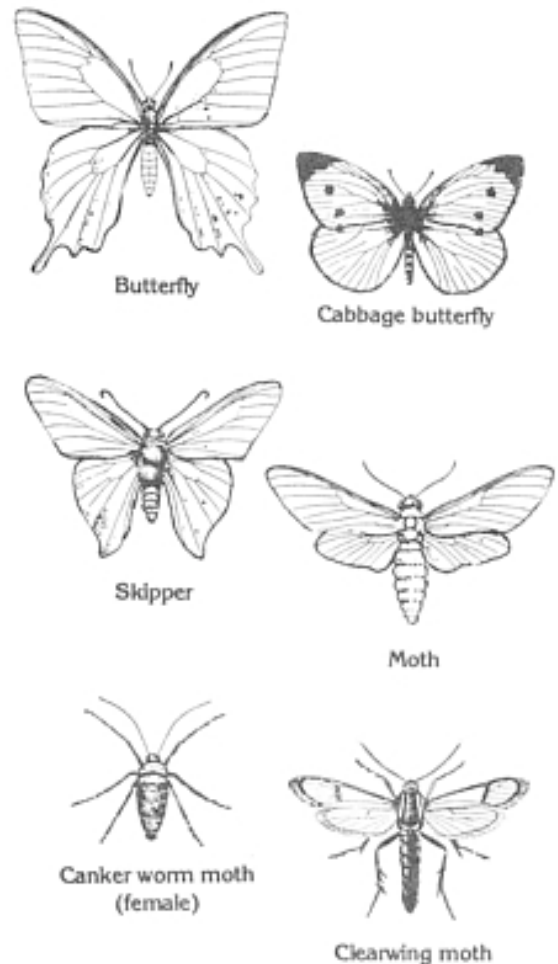
(*trichos* = hair + *ptera* = wings)

Trichoptera are closely related to Lepidoptera, but have chewing mouthparts and wings that are hairy instead of scaly. In side view they often have a triangular outline, and the antennae are long and thread-like. The larvae also differ: caddisfly larvae, unlike butterfly and moth caterpillars, never have abdominal legs with crochets (groups of hooked spines at the end of abdominal legs). Trichoptera have complete metamorphosis, and all caddisfly larvae are fully aquatic. The larvae of many species construct cases around themselves with saliva and bits of twigs, reeds, or sand. This gives them their other common name; “caseflies.” Some construct webbed nets, but no case. Trichoptera are the largest single group of aquatic insects and are an important source of food for fish. The adults, most of which are 1/2- 1 1/2 inches, tend to fly at night and are attracted to lights.

**22. Lepidoptera: Moths, Butterflies, and Skippers**

(*lepidos* = scale + *ptera* = wings)

Lepidoptera are easy to recognize. They have coiled sucking mouthparts, scales on their wings, and complete metamorphosis. The main difference between moths, butterflies, and skippers is in the antennae. Butterflies have thread-like antennae that are thickened or knobbed at the end. Skippers have thread-like, knobbed antennae as well, but the knobs are tipped with distinct hooks. Moth antennae may be thread-like, feathery or spindle shaped, but never have knobs. Most moths fly at night, while butterflies and skippers tend to be day fliers. Most moth caterpillars spin a cocoon in which to pupate, but butterflies never spin a cocoon. A few moths are wingless. Caterpillars of many moths (and a few butterflies and skippers) are important pests of plants. Most caterpillars eat plant leaves, but the caterpillars of some moths eat woolen materials and stored food. Some bore into plants. A few kinds of caterpillars are adapted for living in water. Some caterpillars have poisonous spines on their body, and if they are handled carelessly can produce a sting as bad as a wasp sting.



23. Hymenoptera: Wasps, Bees, Ants, Sawflies, Horntails

(*hymen* = membrane + *ptera* = wings)

Hymenoptera have chewing mouthparts and either two pairs of membranous wings or no wings. When winged, the front pair is longer than the hind pair. The antennae are well developed and often are quite long. In bees, wasps and ants, the body is constricted between the thorax and abdomen, but in sawflies and horntails the abdomen and thorax are broadly joined. All Hymenoptera have complete metamorphosis. Some Hymenoptera are solitary, others are organized into highly socialized colonies. The greatest degree of social organization occurs among the honey bees, but ants are also highly socialized. The social organization of wasps is not as complex. None of the sawflies or horntails lives in colonies. Many of the Hymenoptera, in the process of feeding on pollen, also pollinate flowers and are useful insects for this reason. Honey bees also produce honey, wax, and propolis. Other Hymenoptera are beneficial predators or parasites of pest insects. Many species of sawflies and horntails are pests which feed on leaves or bore in wood. Some bees, wasps and ants are pests. Those that can sting cause the most concern.

